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Cutoff scores for the 8-item version of the Chronic Pain Acceptance Questionnaire (CPAQ-8) to identify different profiles of pain acceptance patterns, levels of function and behavioral flexibility.

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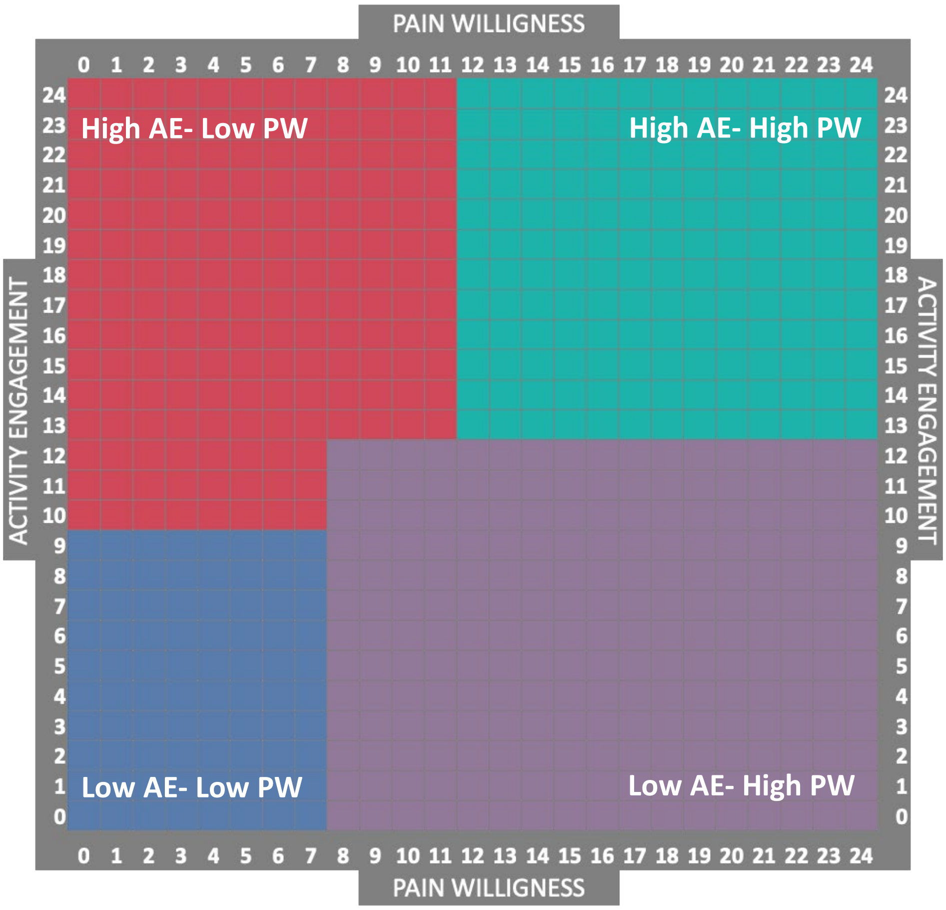
Abstract

Despite their strong evidence, group-based ACT-informed pain rehabilitation programs yield medium to low effect sizes pointing to an uneven responsiveness. This has led to the search for ways to identify differential needs and capacity to change. Previous studies found that Pain Willingness and Activity Engagement cluster into four profiles with distinct behavioral and functional patterns of behavioral flexibility. Clustering could enable the creation of groups with shared rehabilitation needs and could guide the tailoring of process-based rehabilitation.

The statistically created clusters in previous studies are however not easily transferable to clinical practice. This study therefore aimed to create raw score cutoffs to support the clinical implementation of the profiles. The raw scores were developed by visual exploration of the distribution of the CPAQ-8 scores of 1775 patients. The cutoffs' sensitivity and specificity were tested with Operating Characteristic (ROC) and Area Under the Curve (AUC) analysis and capacity to identify the profiles and patterns of behaviors were tested with ANOVA and MANOVA, in comparison to a statistically derived clustering solution. ROC analysis showed that clinical cutoffs could mimic the statistically created clusters with excellent sensitivity and specificity. The AUC ranged between 89.3% and 96.6%. The CPAQ-8 clinical cutoffs identify the same four profiles supporting a systematic assessment, selection and allocation of patients to groups with shared rehabilitation needs, guiding the clinician to tailor ACT-informed packages for each group. Implications for triage and treatment-design are discussed.

Graphical abstract



CPAQ-8 bi-dimensional cutoff (raw) scores identify four different ways to accept pain

(for the printed version, please find the black and white figure on page 34)

Keywords: Chronic Pain, Pain Rehabilitation, Subgroups, Triaging, Acceptance and Commitment Therapy, Chronic Pain Acceptance Questionnaire

Abbreviations

AE: Activity Engagement

CPAQ-8: The Chronic Pain Acceptance Questionnaire 8-items

LCA: Latent Class Analysis

PW: Pain Willingness

SQRP: the Swedish National Quality Registry of Pain Rehabilitation

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Highlights

- CPAQ-8 identifies four patterns of pain acceptance (PA)
- The CPAQ-8 cutoffs are easy to implement in the intake assessment and triage.
- The CPAQ-8 cutoffs create homogenous groups with shared rehabilitation needs
- These PA patterns offer guidance to tailor group-based interventions

Acceptance and Commitment Therapy (ACT) and its Psychological Flexibility model have demonstrated effectiveness in the area of chronic pain (APA, 2011; Hann & McCracken, 2014; Veehof, Trompetter, Bohlmeijer, & Schreurs, 2016). Treatment is often delivered in groups and the group format can improve mental and social functioning by capitalizing on beneficial group processes such as support, perspective taking, and skill sharing (Wandner, Torres, Bartley, George, & Robinson, 2015) with promising long-lasting results (Gustavsson & von Koch, 2017). Uneven responsiveness to group-based rehabilitation programs (low to medium effect sizes), points to the need to better understand what works for whom (Vlaeyen & Morley, 2005; Williams, Eccleston, & Morley, 2012). It is possible that one factor influencing uneven responsiveness is the capacity of group-based programs to sufficiently individualize treatment (Williams et al., 2012). Clinicians are faced with deciding how to triage and allocate patients into stratified groups that will function well in treatment together (Meyer, Denis, & Berquin, 2018).

Grouping patients by symptoms, diagnoses, risk factors, and other constructs has not yet demonstrated clinically relevant usefulness (Morley, Williams, & Eccleston, 2013), leaving the allocation of patients into group rehabilitation programs unsystematized. Williams et al. (2012) suggest a more “psychologically-informed subgrouping of patients, rather than by diagnostic group, should allow better targeted and more effective treatment, although it is still not clear on what basis patients should be grouped” (Williams et al., 2012, p. 20). One psychological dimension that could be usefully used to group patients into functionally similar groups is pain acceptance. Pain acceptance is a potentially useful grouping factor because it meets a number of the criteria needed to improve this field, as outlined by Williams et al. (2012). For example, a) it is derived from an explicit theoretical model guiding treatment development (McCracken & Vowles, 2014); b) specific validated measures exist of the behavior, in this case, the Chronic Pain Acceptance Questionnaire (CPAQ-8); c) the behavior of pain acceptance has been shown to mediate improvements in function following pain management, whether the treatment is ACT based or an alternative form of CBT (Åkerblom, Perrin, Rivano Fischer, & McCracken, 2015; Trompetter, Bohlmeijer, Fox, & Schreurs, 2015) and d) previous studies have shown that pain acceptance can cluster participants into groups that have shared psychological and behavioral characteristics (Rovner, Vowles, Gerdle, & Gillanders, 2015).

Based on the two subscales from the Chronic Pain Acceptance Questionnaire (CPAQ), the Pain Willingness (PW: a mental openness to discomfort) and Activity Engagement (AE: a physical and social behavior of being active and participating in life despite discomfort), patients have been statistically clustered into acceptance-based subgroups. The first studies identified three 'levels' of pain acceptance: one with high, one with low and one with medium pain acceptance (Costa & Pinto-Gouveia, 2011; Payne-Murphy & Beacham, 2015; Vowles, McCracken, McLeod, & Eccleston, 2008). The high and low groups were clearly differentiated in their physical, mental and social functioning, while the medium group (the biggest one) was unclear. This medium group was further clarified using Latent Class Analysis (LCA) (Rovner et al., 2015) with two distinct middle groups emerging: one with high PW but low AE and the other with low PW but high AE. These two clusters had the same level of pain and depression, but differed in their social participation, mental and physical function, implying the need for tailored modules to target these particular needs as proposed by Vowles et al. (2008).

In sum, previous research has shown that pain acceptance clustering can generate four groups that are homogeneous in terms of their functional level and behavioral flexibility by answering only eight items of the CPAQ-8 (Fish, McGuire, Hogan, Morrison, & Stewart, 2010; Rovner, Årestedt, Gerdle, Börsbo, & McCracken, 2014), offering a potentially efficient assessment and triage tool. A significant barrier to implementation in routine settings is that these clusters were generated by sophisticated statistical means (LCA), using large samples, and the limits between the clusters did not create clear cutoffs (see **Figure 0** in the supplementary material).

The current study, therefore, aimed to develop clinically useful cutoff scores to identify the four different pain acceptance patterns found in the statistical clusters, and to test whether the clinical cutoff derived clusters would match the statistically derived clusters in terms of functional level.

Methods

Data gathering

The data was from one pain clinic that reports to the Swedish National Quality Registry of Pain Rehabilitation (SQRP) that gathers data from all the pain clinics to ensure quality of services and support research projects. The patients gave informed consent to be registered into the SQRP and to use their anonymized dataset for research. Permission to conduct the study was obtained from the Regional Ethics Board in Gothenburg (815-12).

Participants

Included in this study were 1775 patients with chronic musculoskeletal pain consecutively referred to an urban specialty multidisciplinary outpatient pain rehabilitation clinic from December 2008 to August 2015.

Measures

Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). The HADS rates the severity of depression and anxiety symptoms in two 7-item subscales. Each item has four Likert responses from 0 to 3, yielding a maximum score of 21 for each component. A score of <7 is taken as a normal result; a score of 8–10 indicates mild/moderate symptoms; and >10 or more indicates severe symptoms (Mykletun, Stordal, & Dahl, 2001; Zigmond & Snaith, 1983). The Swedish translation has shown acceptable psychometric properties, with a Cronbach's alpha coefficient for the total scale of .90 (Lisspers, Nygren, & Söderman, 1997). In the current study, both subscales yielded an alpha of .86.

The Multidimensional Pain Inventory (MPI; Kerns, Turk, & Rudy, 1985) provides a brief assessment of the impact of pain on an individual's life, quality of social support and general activity. The Swedish 61-items has good internal consistency, with a Cronbach's alpha between .62 and .89 across the 12 scales (Bergström et al., 1998; Bergström, Jensen, Linton, & Nygren, 1999; Turk & Rudy, 1987, 1988). In the current study alphas were between .41 and .90 (the Pain interference subscale had the low alpha, all the others were around .90).

***The Chronic Pain Acceptance Questionnaire 8*-items** *(CPAQ-8)* is a psychometrically robust instrument both in English (Baranoff, Hanrahan, Kapur, & Connor, 2012; Fish, Hogan, Morrison, Stewart, & McGuire, 2013; Fish et al., 2010) and in Swedish (Rovner et al., 2014). It is sensitive to rehabilitation changes over time, with good capacity to identify four different clusters of patients with distinct functional levels (Rovner et al., 2015). Pain acceptance is operationalized with two main classes of behaviors represented by respective subscales: *Activity Engagement* ('AE', score range: 0-24), and *Pain Willingness* ('PW', inverted score range: 0-24). The items are rated from 0 (never true) to 6 (always true) and higher values indicate higher acceptance. In the current study, the internal consistency of the AE sub-scale was .81 and the PW .70 (both close to Swedish norms).

The Short Form-36 health survey (SF-36; Ware & Sherbourne, 1992) measures Health-Related Quality of Life by assessing the impact of physical, mental, emotional and social health and pain on daily functioning. It has 36 questions that yield an 8-scale profile of functional health and well-being and Cronbach's alpha (α) for this study were: Physical Functioning .87, Role Physical .85, Bodily Pain .71, General Health .70, Vitality .76, Social Functioning .79, Role Emotional .84, and Mental Health .73 as well as two composite scores: the Physical and the Mental Composite Summary (Sullivan, Karlsson, & Ware, 1995). The internal consistency of the eight scales of the SF-36 in the Swedish norm is between .79 to .93, similar to the US and UK's reliability (Sullivan, Karlsson, Taft, & Ware, 2002).

EuroQuol, quality of life measure, 5 dimensions, 3 levels (EQ-5D; Brooks, 1996; Brooks, Jendteg, Lindgren, Persson, & Bjork, 1991) covers: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression and offers a global self-rating of QoL. It has good psychometric properties across a number of countries, settings and conditions. It calculates a total index score between -0.11 to 1.00 where higher values indicating better health-related QoL (Rabin & de Charro, 2001). The reliability in this study was α=.60.

The Tampa Scale for Kinesiophobia (TSK; Miller, Kori, & Todd, 1991) measures pain-related fear of movement (Vlaeyen, Kole-Snijders, Boeren, & van Eek, 1995) on a 4-point Likert' scale from ''strongly disagree" to ''strongly agree." The total range goes from 17-68 and cutoff for women is 36 and men 38 (Roelofs et al., 2011). The TSK has proven to be a reliable assessment tool for chronic pain (Crombez, Vlaeyen, Heuts, & Lysens, 1999; Vlaeyen et al., 1995) the factor structure demonstrated stability across pain diagnoses and nationalities (Roelofs et al., 2007). Alpha in this study was .62.

Analysis Strategy

The statistical analyses were performed with SPSS for Windows, versions 22 and 23. Statistical significance was set at $p<.05$. Some analyses (such as the LCA replication) were performed solely with the aim to confirm previous cluster solution, therefore are not presented as results and only explained under the next section.

Methodology used to delineate and test the clinical cutoffs

After plotting all the results of a preliminary Latent Class Analysis to corroborate previous findings ("citation removed for blind review") on a matrix (see **Figure 0** in the supplementary material), several delineations of different clean cutoff scores between clusters were visually performed and tested with Receiver Operating Characteristic (ROC) curves and Area Under the Curve (AUC) analyses until the best fit was found. These analyses tested the discrimination capacity of the clinical cutoffs to successfully and approximately match each person to their LCA derived clusters (Hanley & McNeil, 1982).

ANOVA and Tukey's post hoc tests were used to compare differences between the clusters on other study variables. To explore if the clinical clusters corresponded with the LCA clusters regarding the sociodemographic variables, a MANOVA was performed. ANOVA and Tukey's post-hoc tests were also performed to compare differences between the four LCA clusters and the four clusters from the clinical cutoffs in order to track similarities and differences between clustering models.

Results

The group of patients included in this study had a mean age of 41 years; almost 80% were women and 65% born in Sweden. More than 80% of the group had completed high school, and 30% of them, university. Only 10% of the participants were working full time and those not working had been unemployed for a mean of four years. Average pain duration was nine years, more than the average in Sweden, which is around five years. Half of the group had widespread pain, and the second biggest group had neck and shoulder pain. The majority of the patients had visited their doctor more than four times a year due to their pain and all their sociodemographic characteristics (**Table 1**) were representative for patients entering pain specialty clinics in Sweden (SQRP, 2017). The sample was also checked against international samples to see if the Swedish samples could be comparable and representative of other populations around the globe (see **Table A** in the supplementary material for a t-test comparison). In summary, the current sample were equivalent to others in terms of pain severity, pain interference, depression, anxiety, acceptance and most areas of quality of life. There were a few areas where the current sample showed poorer functioning than comparison samples, such as in vitality, social support and life control.

[Insert **Table 1** about here]

Latent Class Analysis (LCA) supported the four clusters-model, as found in previous studies. (For methodology, see X, p. Y "citation removed for blind review" and the 'Preliminary analyses' in the supplementary material for more information).

After visually studying the LCA clusters' distribution (**Figure 0** in the supplementary material), new limits were created and tested. The criterion was to create a straight cutoff that best mimics the characteristics of the original LCA clusters. The following are the raw cutoff values:

Low	AE 0-9, PW 0-7
Low AE, High PW	AE 0-12, PW 8-24
High AE, Low PW	AE 10-12, PW 0-7 and AE 13-24, PW 0-11
High	AE 13-24, PW 12-24

In **Figure 1** a user-friendly version of the cutoffs is visualized.

[Insert **Figure 1** about here]

Correspondence between LCA and clinical algorithm derived clustering.

In order to test and compare the correspondence between clinical cutoffs and LCA derived clustering, four Receiver Operating Characteristic (ROC) curves were executed. **Figures 2a to 2d** depict the Areas Under the Curves (AUC) for each clinical cluster compared with the ones developed with LCA. This curve is an effective measure of accuracy for predicting the probability that a patient that was assigned a clinical cluster will be assigned the corresponding LCA cluster (Hanley & McNeil, 1982). The AUC and CI are found in **Table 2.**

[Insert **Table 2** about here]

Figures 2a – 2d and **Table 2** show that across clusters, sensitivity was found to be excellent (.87 to .97), specificity was also excellent (.01 - .08). The area under the curve ranged between 89.3% and 96.6%. This means that the clinical algorithm can correctly classify patients into their respective LCA-derived cluster membership with excellent sensitivity, specificity and concordance.

[Insert **Figures 2a to 2d** about here]

Uneven numbers of participants were found in each cluster. As can be seen in **Table 2**, 26.4% of the sample were in the low cluster, 41.9% in the low AE/high PW cluster, 18.9% in the high AE/low PW cluster and 12.8% in the high cluster, which likely reflects the normal clinical distribution at a specialty care clinic, given that patients with higher health resources are better treated at the primary care services.

Comparison between the four clinical clusters

To explore if the clinical clusters corresponded with the LCA clusters regarding sociodemographic variables, a MANOVA was performed. Very few differences were found, these were country of origin and education, these results are reported in **Table A** of the supplementary material. In **Table 3**, the capacity of LCA and the clinical cutoffs to differentiate measures of function and symptoms is compared. A significant omnibus effect of cluster membership was indicated for the clinical cutoffs, Wilks' Λ =0.51, $F_{87, 4,246}$ = 12.2, $p < .001$ and for the LCA clusters Wilks' Λ =0.49, $F_{87, 4,246}$ = 13.2, $p < .001$, and most of the one-way ANOVA and pairwise comparisons yielded similar significant differences for both (cutoff with F's > 7.4, p's < .001; LCA with F's > 8.6, p's < .001).

Comparing the means with ANOVA (**Table 3)** and the post-hoc differences between the LCA and the clinical cutoff-clusters revealed the same patterns and significant differences in Anxiety (HAD), Kinesiophobia (TSK), Pain Interference (MPI), Life Control (MPI), Activities away from Home (MPI), General Activity Index (MPI), Physical Functioning (SF-36), Role physical (SF-36), Bodily Pain (SF-36), General Health (SF-36), Social functioning (SF-36), Mental Health and Mental Composite Summary (SF-36). In addition, the same pattern of cluster differences was found on the EQ-5D Quality of life Index subscales of Mobility, Pain problems, and Worries/Anxiety. Furthermore, the clinical cutoffs better differentiated between the MPI subscales of Household Chores, as well as Negative Responses and Social Support.

Table 3 shows that the clinically derived clusters differed in expected directions, such that the low cluster showed significantly worse functioning than all other clusters. This pattern was seen across the domains of anxiety, depression, kinesiophobia, pain severity, interference, life control, affective distress and all domains of the SF-36. The low cluster were not significantly different to the high AE/low PW cluster in terms of social support, distracting responses or solicitous responses.

The low AE/high PW cluster were not significantly different to the high AE/low PW cluster in terms of depression, pain severity, affective distress, social support, solicitous responses, distracting responses, and outdoor activities. However, this profile still showed many more with widespread pain and experiencing worse functioning than the high AE/low PW cluster in the domains of anxiety, kinesiophobia, pain interference, life control, household chores, activities away from home, social and general activities. The low AE/high PW cluster also showed poorer function in terms of physical function, bodily pain, general health, vitality and social function on the SF-36.

The high AE/low PW cluster showed poorer functioning than the high cluster in all domains except social and general activities and vitality. The pattern of results showed that clusters differed in theoretically and clinically predicted ways across important functional domains.

[Insert **Table 3** about here]

Discussion

Previous research has identified four distinct and theoretically sound profiles of pain acceptance using cluster analyses of the two subscales of the Chronic Pain Acceptance Questionnaire: Pain Willingness (PW) and Activity Engagement (AE). However, these statistically generated clusters studies do not readily translate to the individual level to inform clinical assessment and triage decisions. This translational study aimed to develop raw score cutoffs to easily be able to map each client to their cluster and its associated functional/behavioral pattern. The scores for pain willingness and activity engagement are near identical for the clinical clustering, and the LCA derived clustering solutions.

These four profiles differ in their behavioral patterns in theoretically predicted ways, creating groupings of people who are functionally similar in their approach to pain and their behavioral flexibility. In line with prior cluster studies (Costa & Pinto-Gouveia, 2011; Payne-Murphy & Beacham, 2015; Rovner et al., 2015; Vowles et al., 2008), individuals low in both AE and PW, score significantly higher in anxiety, depression, fear of movement, pain severity and interference, and lower in life control, quality of life and functional level (physically, mentally and socially) from the other groups. The only – and expected- dimension that they do not score statistically differently to the next profile (the low AE and higher PW) is on the physical component of SF-36, given that both clusters' low activity engagement is closely associated with low physical capacity or disability (Vowles et al., 2008).

Recent studies exploring the process of pain acceptance identified similar profiles. Biguet (2019) explored how patients explained the process of pain rehabilitation and identified four ways to accept pain that closely resemble the clusters identified in the current study. The informants of the group experiencing pain as a life crisis and expressing the worse functioning, conceptualized acceptance as "a failure" and saw themselves as being the victims of their situation. This group is closest to the 'low' cluster in the current study. The second group was called "tolerating ambivalence" with an ambiguity towards accepting or not accepting their pain, moving or not moving, and for most of the time, they were stuck in uncertainty which reflects the clinical experience of those individuals after crisis or trauma. Intellectually they know that they can survive the crisis and the pain (a mental openness to pain) but they are still uncertain about which way to move (the low activity engagement). The third group in Biguet's analysis, reported a problem-solving mindset and a compulsive overdoing while also struggling to control their pain. They were called "acknowledging the need for change." This group closely resembles the one with low pain willingness and higher activity engagement cluster. The last group in Biguet's analysis talked in terms of acceptance "as liberation," a safe space that reflects the quality of life of the 'High' cluster, with curiosity and capacity to re-frame the meaning of their pain and reach vitality despite their condition.

A similar grouping structure was also identified by Pietilä-Holmner and colleagues among primary care patients describing their transition between acceptance stages as to move "(*i*) from discredited towards obtaining redress; (*ii*) from uncertainty towards knowledge; (*iii*) from loneliness towards togetherness; and (*iv*) acceptance of pain: an ongoing process" (Pietilä Holmner, Stålnacke, Enthoven, & Stenberg, 2018, p. 74). This movement from one way to relate to pain to the next is an interesting feature of pain acceptance as a malleable skill with different steps, opening for the possibility of a stepped care rehabilitation process with four consecutive rehabilitation modules or programs.

Similarly, latent profile analysis has identified four profiles of mindfulness skills in the general population, military personnel, students and depressed samples in several studies: a) low mindfulness, b) judgmental observing high mindfulness, c) non-judgmental awareness and d) high mindfulness. Whilst remaining speculative, it would be predicted that these four profiles of mindfulness skills would be related to the four clusters of pain acceptance identified in the current study. The first two profiles, the low mindfulness and judgmental-observing ones score the poorest mental health (Bravo, Boothe, & Pearson, 2016; Pearson, Lawless, Brown, & Bravo, 2015; Sahdra et al., 2017) at the same low level as do the both profiles low in Activity Engagement in this study. Moreover, this judmental-observing profile also scored higher in PTSD symptoms, alcohol and drug misuse (Bravo, Pearson, & Kelley, 2018), and its associated pattern of ambivalence (Jerg-Bretzke, Walter, Limbrecht-Ecklundt, & Traue, 2013). Similar patterns have been reported in previous studies of people with lower pain acceptance (Åkerblom, Larsson, Malmstrom, Persson, & Westergren, 2019; Cook et al., 2015) and this could be similar to the profile of the Low AE and higher PW in the current study.

Furthermore, among military personnel the judgmental-observing and non-judgmental aware profiles, both had the same level of rumination (Bravo et al., 2018), though their profile of social interaction and romantic relationships were very different. The non-judgemental aware group made more benign attributions and showed secure attachment styles (Kimmes, Durtschi, & Fincham, 2017). The high mindfulness and the non-judgmental aware clusters may correspond in social functioning to the two pain acceptance profiles with higher activity engagement (the High AE & PW and the low PW/high AE) scoring significantly and distinctly higher than the other two in Social Activities (MPI) and in Social functioning (**Table 3**).

Shared findings appear to triangulate across statistical clustering, clinical clustering, mindfulness facet profiles, social attributes and the qualitative approaches from a physiotherapeutic perspective explored by Biguet (2019) and Pietilä-Holmner et al. (2018). This work is at a very early stage and so the following suggestions are offered tentatively, though one implication of these triangulating findings is that delivering treatment to groups of patients who share the same cluster profile has the potential to radically alter how pain management and rehabilitation is delivered. Firstly, intervention could be delivered in different paces or intensities, with high acceptance patients receiving a shorter and more physically intensive intervention, supported self-help, accurate information and plans and tools to resume as much 'normal' and valued activity as is possible for them. Correspondingly the low PW/low AE group may need more time to change given their low behavioral flexibility, slower pace but with a greater number of interdisciplinary professionals involved in treatment and starting with basics of being present and aware.

The high PW/low AE group may need greater emphasis on behavioral experimentation as a way of contacting the costs of their withdrawal from social and physical activity, experimenting with the direct consequences of increasing these activities in a graded fashion. Current thinking around exposure-based interventions may be particularly relevant for this group (e.g. Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). This approach may be characterized by a greater emphasis on exploration of movement, in graded steps, with curiosity, a focus on testing (and violating) expectations around the harmful consequences of activity, reduction of safety behaviors (e.g. stopping, resting, reassurance seeking), exposure to movement and activity across multiple social situations and with different individuals, and occasional deliberate provocation of pain flare ups during the exposure trials. Each of these features is thought to optimize the acquisition of inhibitory learning (that activity may be safe enough), which competes with previous learning (that activity is harmful).

The low PW/high AE group appear more ‘driven’ to avoid pain by struggling with it and its implications for the self via overactivity. This group may benefit from a greater focus on self-acceptance and self-compassion, greater emphasis on slowing down and learning to mindfully choose responding, rather than the ‘compulsive overdoing’ described by Biguet (2019). Whilst this work is at a very early stage of development, the potential to use matched groups of patients and to target treatment in terms of pace, intensity and focus suggests exciting possibilities to improve upon pain management practice. Preliminary empirical evidence supports the hypothesis that the four clusters respond differently to pain rehabilitation, though this work is at an early stage and requires replication and development (X, "citation removed for blind review").

It is of note that uneven numbers of participants were found in each cluster. One reason for the lack of ‘high’ cluster patients is that the data in the current study was drawn from a specialty clinic, providing treatment for longstanding chronic pain. It may be that ‘high’ acceptance patients may be more likely to be successfully treated in primary care, or even capable of doing their own self-care, with corresponding implications for stepped care. Future studies could test this hypothesis using existing epidemiological sample data or recruiting community-based participants with chronic pain who are not seeking treatment at a specialist pain center. It is also evident that the low AE/high PW group is the largest cluster, suggesting that the ‘exploratory movement-based’ intervention speculatively described above could benefit the greatest numbers, with correspondingly fewer participants requiring the more intensive, interdisciplinary, multi-component intervention, or the self-acceptance/self-compassion/mindfulness-based intervention.

A further implication of the use of pain acceptance for clinical clustering in practice is the potential for the clustering to inform the inter-professional team's decision making around pacing, intensity and focus of intervention in functional ways, in particular for members of the team that do not have extensive behavioral therapy training. The advantage of differentiating four patterns of behaviors that are also therapeutic processes such as Pain Willingness and Activity Engagement, is that it allows the clinician and the patient to better understand and focus on behaviors and capacity to make changes (behavioral flexibility), rather than continuing to focus on symptoms or diagnoses (which is often still the dominant mode of understanding for both patients and many healthcare professionals).

Limitations

The findings of the current study are based on routinely collected data in a specialty care clinic in Sweden. As a result, the degree to which these clusters, and the raw score cutoffs, are implementable across the globe remains untested. Additionally, the data all rely on self-report and thus the degree to which clustering can also predict observable behavioral responding is not yet established. Furthermore, the sample was composed of predominantly women, relatively well educated and from a relatively affluent society, and as such sample characteristics may influence the derivation of cutoff scores in both the clinical clustering and the LCA analyses. Another concern was that whilst all the measures were well standardized, the reliability of the QoL measure and the Tampa Scale for Kinesiophobia in this sample both had reliabilities that were on the low side, suggesting that participants may not have been responding to these items in exactly the ways that the measure validation samples did, and the implication that these scores may be less reliable. Finally, whilst this work builds upon a number of previous studies, replicating and extending those findings, the discussion of the clinical implications of these findings remains at an early stage and is offered tentatively.

Future Research

In addition to testing the replicability of the current findings in more ethnically and socioeconomically diverse samples and across a broader range of health care systems, a future program of research in this area is currently investigating the implications of pain acceptance clustering for practice and its implications not only regarding outcomes but pathways effectivity. For this aim, it is also important to remember that pain acceptance may not have a linear pattern, that sometimes patients can be lower in action and higher in willingness and vice versa. Therefore, researchers and clinicians should consider keeping the two useful factors and subscales instead of reporting the total score of the CPAQ-8 (AE+PW).

The cut offs described here may allow standard pain rehabilitation to test whether triaging patients into groups based on these shared characteristics leads to improvements in efficacy, more even responding to treatment, greater group identification, enhanced group support, decreased isolation, and improved social functioning. Subsequently, moving away from standardized, ‘one size fits all’ treatment and basing treatment emphasis on the needs of cluster membership would need to be tested for efficacy, efficiency and economic benefit, in comparison to standard pain rehabilitation (or to one-to-one interventions). Thirdly, the potential for clinical pain acceptance clustering to be used to develop stepped care models of pain intervention that extend into primary care needs to be tested for delivery by non-pain specialists in low-intensity formats. Fourthly, these patterns of behavior may reflect different strategies that people use when they encounter other difficulties, quite separate from living with chronic pain. For example, people may move from a crisis to an ambivalent state and then to highly active problem solving that eventually will lead us to the final step of problem resolution or accetpance. These hypotheses about behavioral flexibility could be tested in other medical fields with patients suffering from chronic or life threatening conditions, where the first impact of the diagnosis may mimic a crisis reaction (marked by significant avoidance). It is possible that the dual focus on open awareness alongside behavioural activity may provide an understanding of subsequent phased responses to adversity that people use to reach a more functional and flexible strategy. If these ideas are empirically supported, this could inform practitioners how to design stepwise and modularized ACT-based group programs for a range of different conditions (Zhang et al., 2017).

Conclusion

Rehabilitation Medicine needs models that support medical professionals to analyze behaviors in a simple but multidimensional and functional manner. The combination of two behaviors and therapeutically modifiable processes of Pain Willingness (PW), the 'mental behavior' of being open to pain and Activity Engagement (AE) the physical, overt and social behavior of being engaged and participating in activities, offers dimensions that doctors, nurses, physiotherapists and occupational therapists can understand and influence.

This study has provided easy to use clinical cutoffs of pain acceptance that point to behavioral flexibility, psychosocial needs and capacity to change for patients with chronic pain. This case conceptualization model will assist the inter-professional pain rehabilitation team to create four groups with shared intervention needs, using only an eight-item, easily scored self-report measure (the CPAQ-8). Grouping patients according to these shared profiles of behavioral patterns and rehabilitation needs may lead to a more even treatment response. Future clinical research will determine if the different clusters show a clear differential responsiveness to treatment, and ultimately if treatment based on the distinct cluster profile can improve the modest effect sizes currently seen in ACT-informed pain rehabilitation clinics.

References

Åkerblom, S., Larsson, J., Malmstrom, E. M., Persson, E., & Westergren, H. (2019). Acceptance: a factor to consider in persistent pain after neck trauma. *Scand J Pain*. doi:10.1515/sjpain-2019-0021

Åkerblom, S., Perrin, S., Rivano Fischer, M., & McCracken, L. M. (2015). The Mediating Role of Acceptance in Multidisciplinary Cognitive-Behavioral Therapy for Chronic Pain. *J Pain, 16*(7), 606-615. doi:10.1016/j.jpain.2015.03.007

APA. (2011). Acceptance and Commitment Therapy for Chronic Pain. *American Psychological Association- Psychological Treatments.* Retrieved from https://www.div12.org/psychological-treatments/disorders/chronic-or-persistent-pain/acceptance-and-commitment-therapy-for-chronic-pain/

Baranoff, J., Hanrahan, S. J., Kapur, D., & Connor, J. P. (2012). Validation of the Chronic Pain Acceptance Questionnaire-8 in an Australian Pain Clinic Sample. *Int J Behav Med*. doi:10.1007/s12529-012-9278-6

Bergström, G., Jensen, I. B., Bodin, L., Linton, S. J., Nygren, A. L., & Carlsson, S. G. (1998). Reliability and factor structure of the Multidimensional Pain Inventory--Swedish Language Version (MPI-S). *PAIN, 75*(1), 101-110. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=9539679

Bergström, G., Jensen, I. B., Linton, S. J., & Nygren, A. L. (1999). A psychometric evaluation of the Swedish version of the Multidimensional Pain Inventory (MPI-S): a gender differentiated evaluation. *European Journal of Pain, 3*(3), 261-273. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=10700354

Biguet, G. (2019). *The meaning of acceptance and body awareness for individuals living with long-term pain : implications for rehabilitation.* (Doctoral). Karolinska Institutet, Stockhholm. Retrieved from http://hdl.handle.net/10616/46571

Bravo, A. J., Boothe, L. G., & Pearson, M. R. (2016). Getting Personal with Mindfulness: a Latent Profile Analysis of Mindfulness and Psychological Outcomes. *Mindfulness, 7*(2), 420-432. doi:10.1007/s12671-015-0459-7

Bravo, A. J., Pearson, M. R., & Kelley, M. L. (2018). Mindfulness and Psychological Health Outcomes: A Latent Profile Analysis among Military Personnel and College Students. *Mindfulness (N Y), 9*(1), 258-270. doi:10.1007/s12671-017-0771-5

Brooks, R. G. (1996). EuroQol: the current state of play. *Health Policy, 37*(1), 53-72. doi:0168851096008226 [pii]

Brooks, R. G., Jendteg, S., Lindgren, B., Persson, U., & Bjork, S. (1991). EuroQol: health-related quality of life measurement. Results of the Swedish questionnaire exercise. *Health Policy, 18*(1), 37-48. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=10112300

Cook, A. J., Meyer, E. C., Evans, L. D., Vowles, K. E., Klocek, J. W., Kimbrel, N. A., . . . Morissette, S. B. (2015). Chronic pain acceptance incrementally predicts disability in polytrauma-exposed veterans at baseline and 1-year follow-up. *Behav Res Ther, 73*, 25-32. doi:10.1016/j.brat.2015.07.003

Costa, J., & Pinto-Gouveia, J. (2011). Acceptance of pain, self-compassion and psychopathology: Using the Chronic Pain Acceptance Questionnaire to identify patients' subgroups. *Clin Psychol Psychother, 18*(4), 292-302. doi:10.1002/cpp.718

Craske, M. G., Treanor, M., Conway, C. C., Zbozinek, T., & Vervliet, B. (2014). Maximizing exposure therapy: an inhibitory learning approach. *Behaviour Research and Therapy, 58*, 10-23. doi:10.1016/j.brat.2014.04.006

Crombez, G., Vlaeyen, J. W., Heuts, P. H., & Lysens, R. (1999). Pain-related fear is more disabling than pain itself: evidence on the role of pain-related fear in chronic back pain disability. *PAIN, 80*(1-2), 329-339. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=10204746

Fish, R. A., Hogan, M. J., Morrison, T. G., Stewart, I., & McGuire, B. E. (2013). Willing and able: a closer look at pain Willingness and Activity Engagement on the Chronic Pain Acceptance Questionnaire (CPAQ-8). *J Pain, 14*(3), 233-245. doi:10.1016/j.jpain.2012.11.004

Fish, R. A., McGuire, B., Hogan, M., Morrison, T. G., & Stewart, I. (2010). Validation of the chronic pain acceptance questionnaire (CPAQ) in an Internet sample and development and preliminary validation of the CPAQ-8. *PAIN, 149*(3), 435-443. doi:10.1016/j.pain.2009.12.016

Gustavsson, C., & von Koch, L. (2017). A 9-year follow-up of a self-management group intervention for persistent neck pain in primary health care: a randomized controlled trial. *J Pain Res, 10*, 53-64. doi:10.2147/JPR.S125074

Hanley, J. A., & McNeil, B. J. (1982). The meaning and use of the area under a receiver operating characteristic (ROC) curve. *Radiology, 143*(1), 29-36. doi:10.1148/radiology.143.1.7063747

Hann, K. E. J., & McCracken, L. M. (2014). A systematic review of randomized controlled trials of Acceptance and Commitment Therapy for adults with chronic pain: Outcome domains, design quality, and efficacy. *Journal of Contextual Behavioral Science, 3*(4), 217-227. doi:http://dx.doi.org/10.1016/j.jcbs.2014.10.001

Jerg-Bretzke, L., Walter, S., Limbrecht-Ecklundt, K., & Traue, H. C. (2013). Emotional ambivalence and post-traumatic stress disorder (PTSD) in soldiers during military operations. *Psycho-social medicine, 10*, Doc03-Doc03. doi:10.3205/psm000093

Kerns, R. D., Turk, D. C., & Rudy, T. E. (1985). The West Haven-Yale Multidimensional Pain Inventory (WHYMPI). *PAIN, 23*(4), 345-356. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=4088697

Kimmes, J. G., Durtschi, J. A., & Fincham, F. D. (2017). Perception in Romantic Relationships: a Latent Profile Analysis of Trait Mindfulness in Relation to Attachment and Attributions. *Mindfulness, 8*(5), 1328-1338. doi:10.1007/s12671-017-0708-z

Lisspers, J., Nygren, A., & Söderman, E. (1997). Hospital Anxiety and Depression Scale (HAD): some psychometric data for a Swedish sample. *Acta Psychiatr Scand, 96*(4), 281-286. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=9350957

McCracken, L. M., & Vowles, K. E. (2014). Acceptance and commitment therapy and mindfulness for chronic pain: Model, process, and progress. *Am Psychol, 69*(2), 178-187. doi:10.1037/a0035623

Meyer, C., Denis, C. M., & Berquin, A. D. (2018). Secondary prevention of chronic musculoskeletal pain: A systematic review of clinical trials. *Ann Phys Rehabil Med, 61*(5), 323-338. doi:10.1016/j.rehab.2018.03.002

Miller, R., Kori, S., & Todd, D. (1991). *The Tampa Scale for Kinesiophobia.* Unpublished report. Tampa, FL.

Morley, S., Williams, A., & Eccleston, C. (2013). Examining the evidence about psychological treatments for chronic pain: Time for a paradigm shift? *PAIN, 154*(10), 1929-1931. doi:http://dx.doi.org/10.1016/j.pain.2013.05.049

Mykletun, A., Stordal, E., & Dahl, A. A. (2001). Hospital Anxiety and Depression (HAD) scale: factor structure, item analyses and internal consistency in a large population. *Br J Psychiatry, 179*, 540-544. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=11731359

Payne-Murphy, J. C., & Beacham, A. O. (2015). Revisiting Chronic Pain Patient Profiling: An Acceptance-based Approach in an Online Sample. *Clin Psychol Psychother, 22*(3), 240-248. doi:10.1002/cpp.1886

Pearson, M. R., Lawless, A. K., Brown, D. B., & Bravo, A. J. (2015). Mindfulness and Emotional Outcomes: Identifying Subgroups of College Students using Latent Profile Analysis. *Pers Individ Dif, 76*, 33-38. doi:10.1016/j.paid.2014.11.009

Pietilä Holmner, E., Stålnacke, B. M., Enthoven, P., & Stenberg, G. (2018). "The acceptance" of living with chronic pain - an ongoing process: A qualitative study of patient experiences of multimodal rehabilitation in primary care. *J Rehabil Med, 50*(1), 73-79. doi:10.2340/16501977-2286

Rabin, R., & de Charro, F. (2001). EQ-5D: a measure of health status from the EuroQol Group. *Ann Med, 33*(5), 337-343. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11491192

Roelofs, J., Sluiter, J. K., Frings-Dresen, M. H., Goossens, M., Thibault, P., Boersma, K., & Vlaeyen, J. W. (2007). Fear of movement and (re)injury in chronic musculoskeletal pain: Evidence for an invariant two-factor model of the Tampa Scale for Kinesiophobia across pain diagnoses and Dutch, Swedish, and Canadian samples. *PAIN, 131*(1-2), 181-190. doi:10.1016/j.pain.2007.01.008

Roelofs, J., van Breukelen, G., Sluiter, J., Frings-Dresen, M. H., Goossens, M., Thibault, P., . . . Vlaeyen, J. W. (2011). Norming of the Tampa Scale for Kinesiophobia across pain diagnoses and various countries. *PAIN, 152*(5), 1090-1095. doi:10.1016/j.pain.2011.01.028

Rovner, G. S., Årestedt, K., Gerdle, B., Börsbo, B., & McCracken, L. M. (2014). Psychometric properties of the 8-item Chronic Pain Acceptance Questionnaire (CPAQ-8) in a Swedish chronic pain cohort. *J Rehabil Med, 46*(1), 73-80. doi:10.2340/16501977-1227

Rovner, G. S., Vowles, K. E., Gerdle, B., & Gillanders, D. (2015). Latent Class Analysis of the Short and Long Forms of the Chronic Pain Acceptance Questionnaire: Further Examination of Patient Subgroups. *J Pain, 16*(11), 1095-1105. doi:10.1016/j.jpain.2015.07.007

Sahdra, B. K., Ciarrochi, J., Parker, P. D., Basarkod, G., Bradshaw, E. L., & Baer, R. (2017). Are People Mindful in Different Ways? Disentangling the Quantity and Quality of Mindfulness in Latent Profiles and Exploring their Links to Mental Health and Life Effectiveness. *European Journal of Personality, 31*(4), 347-365. doi:10.1002/per.2108

SQRP, The Swedish Quality Registry for Pain Rehabilitation. (2017). Annual report Specialty Care 2016 part 1, Swedish National Quality Register of Pain Rehabilitation (SQRP) [Spcialistvård

Rapport 2016 del 1 Nationella Registret över Smärtrehabilitering]. *Repport 2017:1.* Retrieved from http://www.ucr.uu.se/nrs/index.php/arsrapporter

Sullivan, M., Karlsson, J., Taft, C., & Ware, J. E. (2002). *SF-36 hälsoenkät : svensk manual och tolkningsguide (Swedish manual and interpretation guide)* (2. uppl. ed.). Göteborg: Sahlgrenska sjukhuset, Sektionen för vårdforskning.

Sullivan, M., Karlsson, J., & Ware, J. E. (1995). The Swedish SF-36 Health Survey--I. Evaluation of data quality, scaling assumptions, reliability and construct validity across general populations in Sweden. *Soc Sci Med, 41*(10), 1349-1358. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=8560302

Trompetter, H. R., Bohlmeijer, E. T., Fox, J. P., & Schreurs, K. M. (2015). Psychological flexibility and catastrophizing as associated change mechanisms during online Acceptance & Commitment Therapy for chronic pain. *Behav Res Ther, 74*, 50-59. doi:10.1016/j.brat.2015.09.001

Turk, D. C., & Rudy, T. E. (1987). Towards a comprehensive assessment of chronic pain patients. *Behav Res Ther, 25*(4), 237-249. doi:0005-7967(87)90002-7 [pii]

Turk, D. C., & Rudy, T. E. (1988). Toward an empirically derived taxonomy of chronic pain patients: integration of psychological assessment data. *J Consult Clin Psychol, 56*(2), 233-238. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=3372831

Veehof, M. M., Trompetter, H. R., Bohlmeijer, E. T., & Schreurs, K. M. (2016). Acceptance- and mindfulness-based interventions for the treatment of chronic pain: a meta-analytic review. *Cogn Behav Ther, 45*(1), 5-31. doi:10.1080/16506073.2015.1098724

Vlaeyen, J. W., Kole-Snijders, A. M., Boeren, R. G., & van Eek, H. (1995). Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance. *PAIN, 62*(3), 363-372. doi:030439599400279N [pii]

Vlaeyen, J. W., & Morley, S. (2005). Cognitive-behavioral treatments for chronic pain: what works for whom? *Clin J Pain, 21*(1), 1-8. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=15599126

Vowles, K. E., McCracken, L. M., McLeod, C., & Eccleston, C. (2008). The Chronic Pain Acceptance Questionnaire: confirmatory factor analysis and identification of patient subgroups. *PAIN, 140*(2), 284-291. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=18824301

Wandner, L. D., Torres, C. A., Bartley, E. J., George, S. Z., & Robinson, M. E. (2015). Effect of a perspective-taking intervention on the consideration of pain assessment and treatment decisions. *J Pain Res, 8*, 809-818. doi:10.2147/JPR.S88033

Ware, J. E., & Sherbourne, C. D. (1992). The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care, 30*(6), 473-483. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=1593914

Williams, A. C., Eccleston, C., & Morley, S. (2012). Psychological therapies for the management of chronic pain (excluding headache) in adults. *Cochrane Database Syst Rev, 11*, CD007407. doi:10.1002/14651858.CD007407.pub3

Zhang, C. Q., Leeming, E., Smith, P., Chung, P. K., Hagger, M. S., & Hayes, S. C. (2017). Acceptance and Commitment Therapy for Health Behavior Change: A Contextually-Driven Approach. *Front Psychol, 8*, 2350. doi:10.3389/fpsyg.2017.02350

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatr Scand, 67*(6), 361-370. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=6880820

Tables and Figures

The following section presents:

1. Supplementary materials
2. The tables that are part of the manuscript
3. Figures that are part of the manuscript

Supplementary Materials

Preliminary analyses

Figure 0: Visualization of the clusters generated by the LCA. This matrix represents the distribution of patients, the numbers in each cell are the number of patients scoring that particular combination of CPAQ-8 subscales, AE and PW.

Table A: Descriptive data and comparative tests for all measures.

Main tables: Tables 1, 2 and 3

Table 1: Socio-demographics and pain characteristics for the total group and comparisons between the LCA-clusters and the cutoff-generated clusters

Table 2: The so called the ACTiveAssessment's reticulated cutoffs for the raw values of the CPAQ (see Figure 1), their area under the ROC curves (see Figures 3a to 3d).

Table 3: Means (SD) and between cluster comparisons for measures of functioning.

Supplementary material

Preliminary analyses (not included in the results, only as supplementary material)

All dependent variables were normally distributed with all values for skew or kurtosis less than 1.5 (Tabachnick & Fidell, 2007) and there were no statistical outliers for the distribution for the CPAQ subscales.

Latent Class Analysis (LCA) was used to corroborate the four clusters model according to previous studies (for methodology, see X, p. Y "citation removed for blind review") only to confirm that this population would generate the same four clusters.

All the measures of the SQRP were included to perform Pearsons' correlation and also to ensure that a) a similar pattern of relationship between the LCA clusters and the clinical-cutoffs that we aimed to generate mapped into the same pattern of differences and b) to compare if there were similarities with the clusters found in Rovner et al. (2015).

The sample in this study was 30% bigger than that of X (citation removed for blind review) (N=1175 vs. 907); both samples had equivalent pain severity and duration. The same four clusters were identified, with the same mean levels of acceptance in both subscales Activity Engagement and Pain Willingness.

Figure 0 supplementary material

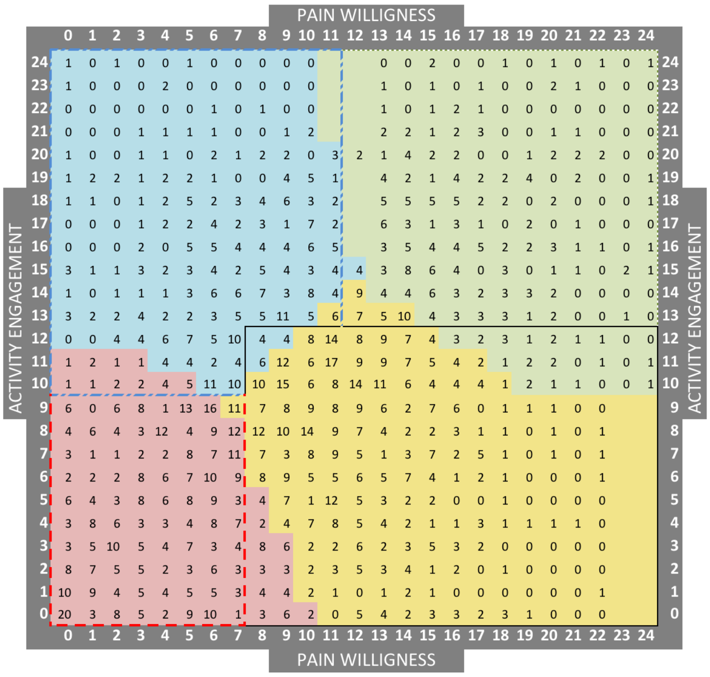

Figure 0. Visualization of the clusters generated by the LCA This matrix represents the distribution of patients, the numbers in each cell are the number of patients scoring that particular combination of CPAQ-8 subscales, AE and PW. The LCA clusters are marked with different colors while the clinical cutoffs are delineated with different lines (see also **Figure 1**). The green area represents patients that scored high in both AE and PW (upper right), while the red area represents the patients that scored low in both (lower left). The yellow area are the patients that scored higher in Pain willingness than in Activity Engagement (lower right) and the blue area represent the opposite combination (the upper-left).

Table A (supplementary material)

Descriptive Data and Comparative Tests For all Measures.

Variable *(total completers N)*	Current study (*N*=1775)		Comparative data				*t*-Test
	Mean	**SD**	**Country/ies were the populations was studied**	**N**	**Mean**	**SD**	***p***
CPAQ-8 AE (1775)	9.6	5.66	AU, IE, US, CA, AU, GB, NZ[1]	1312	12.6	5.58	N.S
CPAQ-8 PW (1775)	9.3	5.26	AU, IE, US, CA, AU, GB, NZ[1]	1312	8.7	5.04	N.S
HAD Anxiety (1774)	9.5	4.74	SE, AU, BE, DE[2]	680	11.0	4.71	N.S
HAD Depression (1774)	10.6	5.01	SE, AU, BE, DE[2]	680	10.6	4.70	N.S
TSK Kinesiophobia (1721)	40.9	9.81	DE[3]	97	36.8	7.64	N.S
MPI							
Pain Severity (1763)	4.6	0.90	MPI norm, heterogenous[4]	6532	4.3	1.25	N.S
Interference (1754)	4.6	1.04	MPI norm, heterogenous[4]	6532	4.1	1.48	N.S
Life Control (1761)	2.4	1.17	MPI norm, heterogenous[4]	6532	3.0	1.35	<0.001
Affective Distress (1760)	3.8	1.25	MPI norm, heterogenous[4]	6532	3.4	1.34	N.S
Social Support (1757)	4.1	1.40	MPI norm, heterogenous[4]	6532	4.4	1.60	<0.001
Negative Responses (1612)	2.0	1.50	MPI norm, heterogenous[4]	6532	1.8	1.62	N.S
Solicitous Responses (1608)	3.1	1.51	MPI norm, heterogenous[4]	6532	3.4	1.57	N.S
Distracting Responses (1606)	2.5	1.25	MPI norm, heterogenous[4]	6532	2.3	1.45	N.S
Household Chores (1762)	3.2	1.49	MPI norm heterogenous[5]	500	2.8	1.72	N.S
Outdoor Activities (1760)	1.4	1.42	MPI norm heterogenous[5]	500	1.1	1.36	N.S
Activities Away from Home (1762)	1.8	1.10	MPI norm heterogenous[5]	500	2.3	1.28	<0.001
Social Activities (1762)	2.4	1.07	MPI norm heterogenous[5]	500	2.0	1.20	N.S
General Activity Index (1763)	2.2	0.97	MPI norm heterogenous[5]	500	2.22	1.1	N.S
SF-36							
Physical functioning (1767)	48.9	22.22	'Latinas' in the US[6]	42	44.9	23.4	N.S
Role physical (1747)	12.2	24.59	'Latinas' in the US[6]	42	5.3	15.3	N.S
Bodily Pain (1769)	21.6	14.39	'Latinas' in the US[6]	42	30.5	18.9	0.002
General health (1760)	35.1	20.62	'Latinas' in the US[6]	42	34.2	19.0	N.S
Vitality (1770)	20.8	17.80	'Latinas' in the US[6]	42	35.6	16.9	<0.001
Social functioning (1771)	41.5	25.66	'Latinas' in the US[6]	42	42.2	19.3	N.S
Role emotional (1726)	38.0	41.90	'Latinas' in the US[6]	42	14.1	21.1	N.S
Mental Health (1767)	49.4	22.30	'Latinas' in the US[6]	42	41.1	19.9	N.S

Variable *(total completers N)*	**Current study** (N=1775)		**Comparative data**				***t*-Test**
	Mean	**SD**	**Country/ies were the populations was studied**	**N**	**Mean**	**SD**	***p***
Physical Component Summary (1697)	28.2	8.07	BE[7]	527	30.8	7.76	<0.001
Mental Component Summary (1697)	33.9	12.75	BE[7]	527	26.2	12.04	N.S
EQ-5D							
VAS (1721)	38.0	19.47					
EQ-index (1721)	0.2	0.31	US (CWP no FM)[8]	176	0.7	0.18	<0.001
EQ-index (1721)	0.2	0.31	US (FM)[8]	171	0.6	0.21	<0.001
EQ-index (1721)	0.2	0.31	FR, BE, CH (LBP)[8]	150	0.4	0.2	<0.001

[1] CPAQ-8: The Chronic Pain Acceptance Questionnaire 8-items (Baranoff, Hanrahan, Kapur, & Connor, 2014; Fish et al., 2013; Fish et al., 2010)
[2] HAD: The Hospital Anxiety and Depression scale. SE: Swedish article: (Cederberg et al., 2015); AU: Australian article (Baranoff et al., 2012); DE: German article (Holzapfel, Riecke, Rief, Schneider, & Glombiewski, 2016); BE: Belgian article (Vanhaudenhuyse et al., 2015)
[3] TSK: DE: German article (Holzapfel et al., 2016)
[4] Multidimensional pain inventory normative data from 2004 for Heterogeneous Chronic Pain sample ©Kerns, Turk, & Rudy
[5] Multidimensional pain inventory normative data from 1987 for Heterogeneous Chronic Pain sample ©Kerns, Turk, & Rudy http://www.pain.pitt.edu/mpi/MPI_Norms.pdf
[6] SF-36 BE: Dominican, Puerto Rican and South American underserved women living in the US (Geller, Kulla, & Shoemaker, 2015)
[7] SF-36 BE: Belgian article (Vanhaudenhuyse et al., 2015)
[8] EQ-5D: EuroQoL index score. US: United States of America (Schaefer et al., 2015); FR: France; BE: Belgium; CH: Switzerland (Cedraschi et al., 2015)

TABLES:

Table 1 *Socio-Demographics and Pain Characteristics for the Total Group and comparisons between the LCA-clusters and the Cutoffs-Generated Clusters*

Variable *(total completers N)*	**TOTAL** (*N*=1775) Mean *(SD) or %*	**LOW** Mean *(SD) or %*		**Low AE- High PW** Mean *(SD) or %*		**High AE - Low PW** Mean *(SD) or %*		**HIGH** Mean *(SD) or %*	
		LCA-clusters *(N=526)*	Clinical Algorithm *(N=468)*	**LCA-clusters** *(N=654)*	Clinical Algorithm *(N=744)*	**LCA-clusters** *(N=347)*	Clinical Algorithm *(N=336)*	**LCA-clusters** *(N=242)*	Clinical Algorithm *(N=227)*
Age (years) *(1775)*	40.6 (10.40)	39.5 (10.48)a	40.2 (10.64)	40.3 (10.61)b	39.8(10.53)	40.3 (10.11)b	41.3 (10.14)	40.2 (10.42)b	40.1(10.44)
Women *(1394)*	78.5%	79.5% b	72.6% aa	72.9% a	78.3% bb	80.0% b	80.5%bb	84.9% c	84.6%bb
Country of origin/birth *(1765)*									
Sweden (1160)	65.7%	60.6% a	56.0% aa	55.8% a	59.1% aa	69.7% ab	69.6% bb	82.6% b	82.8% bb
other Nordic countries (45)	2.5%	2.0%	2.8%	3.4%	2.7%	2.2%	2.7%	2.3%	1.3%
Born in Europe (96)	5.4%	7.3%	5.3%	5.5%	7.3%	5.0%	5.0%	3.9%	4.4%
Born in the rest of the world (464)	26.3%	30.0% bc	35.9% bb	35.2% c	30.9% bb	23.0% b	22.7% aa	11.2% a	11.5% aa
Education *(1756)*									
Elementary school *(255)*	14.5%	14.7% b	19.0% bb	20.0% c	16.4% aabb	11.8% a	12.3% aa	10.1% a	9.7% aa
High school education (or vocational) *(947)*	53.9%	58.8% c	54.3% bb	53.9% b	58.4% bb	55.3% b	54.9% bb	44.2% a	43.4% aa
University education *(469)*	26.7%	22.1% a	21.4% aa	21.1% a	21.6% aa	28.1% b	27.6% bb	40.7%c	42.0% cc
Other education *(85)*	4.8%	4.4%	5.2% bb	5.0%	3.6% aa	4.9%	5.1% bb	5.0%	4.9% bb
Working/studying 1-25 % *(23)*	1.3%	.9% a	1.3% aa	1.1% a	1.2% aa	1.6% b	1.2% aa	1.5% b	1.8% bb

Variable *(total completers N)*	**TOTAL** (*N*=1775) Mean *(SD) or %*	**LOW** Mean *(SD) or %*		**Low AE- High PW** Mean *(SD) or %*		**High AE - Low PW** Mean *(SD) or %*		**HIGH** Mean *(SD) or %*	
		LCA-clusters *(N=526)*	Clinical Algorithm *(N=468)*	**LCA-clusters** *(N=654)*	Clinical Algorithm *(N=744)*	**LCA-clusters** *(N=347)*	Clinical Algorithm *(N=336)*	**LCA-clusters** *(N=242)*	Clinical Algorithm *(N=227)*
Working/studying 26-50 % *(93)*	5.2%	5.8% b	4.3% aa	4.0% a	5.1% aa	5.6% b	5.4% aa	6.2% b	7.0% bb
Working/studying 51-75 % *(59)*	3.3%	2.6% a	1.9%aa	2.1% a	3.0% bb	3.9% b	3.8% bb	5.4%c	5.3% cc
Working/studying 76-99 % *(21)*	1.2%	0.9% a	1.5% bb	1.1% a	0.9% aa	0.9% a	0.8% aa	2.3% b	2.2% cc
Working/studying 100 % *(168)*	9.5%	15.0% b	7.9% aa	7.2% a	13.4% bb	5.9% a	6.6% aa	15.4% b	16.3% bb
Living alone *(305)*	18.2%	15.5%	19.5%	19.9%	15.5%	18.9%	19.3%	16.7%	16.0%
More than 4 medical visits (past year) *(1326)*	77.5%	73.2% b	86.4% cc	86.1% c	72.3% bb	81.7% c	81.4% cc	55.8% a	54.1%aa
Pain severity (min 0-max 6) *(1775)*	4.1 (1.18)	4.4 (1.18)c	4.4 (1.17) cc	4.1 (1.1) b	4.1 (1.23) bb	3.6 (1.13)a	4.1 (1.12) bb	4.1 (1.18) b	3.6 (1.10) aa
Pain duration (years) *(1775)*	9.0 (9.98)	8.9 (10.16)	8.9 (10.26)	9.0 (9.82)	9.0 (10.07)	8.9 (10.76)	8.9 (10.05)	9.0 (8.88)	9.1 (8.95)
Persistent pain duration (days) *(1775)*	7.3 (8.91)	7.6 (10.54)	7.5 (10.81)	7.0 (7.86)	7.1 (7.86)	6.9 (8.65)	7.1 (8.89)	7.8 (7.50)	7.8 (7.24)
Days since occupationally active *(1775)*	3.9 (9.52)	3.2 (3.91)	3.1 (3.73)	4.4 (12.22)	4.4 (11.56)	4.5 (12.76)	4.6 (12.82)	3.1 (4.19)	3.4 (4.29)
Number of pain locations (0-36) *(1775)*	17.1 (9.11)	17.2 (9.35) ab	17.3 (9.24) aa	18.3 (9.14) b	16.3 (9.18) aa	16.4 (9.23) a	18.1 (9.20) bb	16.6 (8.40) a	16.5 (8.40) aa
Pain localizations *(1775)*									
Head & face *(114)*	6.5%	36.0%	31.6%	35.1%	40.3%	14.0%	12.3%	14.6%	13.2%
Neck *(262)*	14.9%	25.6%	24.0%	36.6%	40.8%	21.0%	19.8%	16.8%	15.3%

Variable *(total completers N)*	**TOTAL** (*N*=1775) Mean *(SD) or %*	**LOW** Mean *(SD) or %*		**Low AE- High PW** Mean *(SD) or %*		**High AE - Low PW** Mean *(SD) or %*		**HIGH** Mean *(SD) or %*	
		LCA-clusters *(N=526)*	Clinical Algorithm *(N=468)*	**LCA-clusters** *(N=654)*	Clinical Algorithm *(N=744)*	**LCA-clusters** *(N=347)*	Clinical Algorithm *(N=336)*	**LCA-clusters** *(N=242)*	Clinical Algorithm *(N=227)*
Shoulders & upper limbs *(149)*	8.5%	22.1%	20.1%	35.6%	41.6%	25.5%	22.8%	16.8%	15.4%
Chest *(14)*	0.8%	42.9%	35.7%	28.6%	21.4%	21.4%	28.6%	7.1%	14.3%
Abdomen *(20)*	1.1%	25.0%	25.0%	50.0%	55.0%	20.0%	15.0%	5.0%	5.0%
Sexual organs and groin *(4)*	0.2%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
Upper back *(56)*	3.2%	21.4%	16.1%	41.1%	48.2%	19.6%	21.4%	17.9%	14.3%
Lower back *(187)*	10.6%	39.0% $_b$	35.3% $_{bb}$	28.9% $_a$	34.8% $_{bb}$	18.7% $_a$	16.6% $_{aa}$	13.4% $_a$	13.4% $_{aa}$
Hips *(43)*	2.4%	32.6%	30.2%	37.2%	44.2%	11.6%	14.0%	18.6%	11.6%
Lower limbs/legs *(48)*	2.7%	25.0%	22.9%	35.4%	39.6%	22.9%	20.8%	16.7%	16.7%
Widespread pain *(859)*[1]	48.9%	30.2%	26.1%	37.4%	43.7%	19.2%	19.2%	13.3%	11.1%

[1] The pain is not localized in one area; it varies around several body-regions.

Table 2

The Raw Scores Cutoffs tor the Pain Acceptance (See ›), Their Area Under the ROC Curves (See ***Figures 2a to 2d****)*

CPAQ-8 (*N*=1775)	**Low** *N*= 468 (26.37%)	**Low AE-High PW** *N*=744 (41.91%)	**High AE - Low PW** *N*=336 (18.93%)	**High** *N*=227 (12.79%)
Cutoffs	AE 0-9, PW 0-7	AE 0-12, PW 8-24	AE 13-24, PW 0-11 & AE 10-12, PW 0-7	AE 13-24, PW 12-24
AUC % (CI)	96.4% (95.5%-97.3%)	93.3% (92.0%-94.5%)	89.3% (86.4%-92.2%)	96.6% (95.5%-97.6%)

The AUC can be interpreted as the probability that a randomly chosen subject that appertain to one LCA cluster is rated as more likely to be included in the corresponding cluster of the clinical algorithm than a randomly chosen subject that appertain to another LCA cluster (Hanley & McNeil, 1982)

Table 3

Functional Levels (M*eans* And *SD) For The Total Group And For Each Cluster And Identification Of Significant Differences Between Them.*

Variable *(total completers N)*	**TOTAL** *(N=1775)* Mean *(SD)*	**LOW** Mean *(SD)*		**Low AE- High PW** Mean *(SD)*		**High AE - Low PW** Mean *(SD)*		**HIGH** Mean *(SD)*	
		LCA-clusters (N=526)	**Clinical Algorithm (N=468)**	**LCA-clusters** *(N=654)*	**Clinical Algorithm** *(N=744)*	**LCA-clusters** *(N=347)*	**Clinical Algorithm** *(N=336)*	**LCA-clusters** *(N=242)*	**Clinical Algorithm** *(N=227)*
CPAQ-8 AE (1775)	9.6 (5.66)	4.6 (3.2)$_{a}$	4.6 (3.0)$_{aa}$	7.9 (3.4)$_{b}$	7.9 (3.7)$_{bb}$	15.0 (3.1)$_{c}$	14.9 (3.3)$_{cc}$	16.7 (3.3)$_{d}$	17.4 (2.7)$_{dd}$
CPAQ-8 PW (1775)	9.3 (5.26)	4.0 (2.6)$_{a}$	3.7 (2.4)$_{aa}$	12.1 (2.8)$_{c}$	12.2 (3.3)$_{cc}$	6.7 (2.8)$_{b}$	6.1 (3.0)$_{bb}$	16.7 (3.1)$_{d}$	15.8 (3.0)$_{dd}$
HAD Anxiety (1774)	9.5 (4.74)	12.1 (4.37)$_{d}$	12.0 (4.32)$_{dd}$	9.9 (4.43)$_{c}$	9.9 (4.48)$_{cc}$	7.6 (4.05)$_{b}$	7.9 (4.14)$_{bb}$	5.9 (3.64)$_{a}$	5.4 (3.48)$_{aa}$
HAD Depression (1774)	10.6 (5.01)	13.0 (4.66)$_{c}$	12.9 (4.67)$_{cc}$	10.3 (4.88)$_{b}$	10.3 (4.86)$_{bb}$	10.0 (4.69)$_{b}$	10.3 (4.80)$_{bb}$	7.4 (4.18)$_{a}$	7.4 (4.27)$_{aa}$
TSK Kinesiophobia (1721)	40.9 (9.81)	46.6 (8.99)$_{d}$	46.6 (9.04)$_{dd}$	39.2 (8.42)$_{b}$	39.1 (8.58)$_{bb}$	42.2 (9.16)$_{c}$	43.0 (9.41)$_{cc}$	32.0 (7.17)$_{a}$	32.1 (7.03)$_{aa}$
MPI									
Pain Severity (1763)	4.6 (.90)	5.0 (.77)$_{c}$	4.9 (.79)$_{cc}$	4.6 (.83)$_{b}$	4.6 (.85)$_{bb}$	4.5 (.90)$_{b}$	4.5 (.90)$_{bb}$	4.0 (.98)$_{a}$	3.9 (.94)$_{aa}$
Interference (1754)	4.6 (1.04)	5.2 (.65)$_{d}$	5.2 (.64)$_{dd}$	4.7 (.79)$_{c}$	4.7 (.81)$_{cc}$	4.2 (.97)$_{b}$	4.3 (1.99)$_{bb}$	3.4 (1.20)$_{a}$	3.4 (1.22)$_{aa}$
Life Control (1761)	2.4 (1.17)	1.9 (1.11)$_{a}$	1.9 (1.10)$_{aa}$	2.4 (1.07)$_{b}$	2.4 (1.08)$_{bb}$	2.9 (1.06)$_{c}$	2.8 (1.10)$_{cc}$	3.2 (1.01)$_{d}$	3.2 (1.03)$_{dd}$
Affective Distress (1760)	3.8 (1.25)	4.4 (1.11)$_{c}$	4.4 (1.11)$_{cc}$	3.7 (1.17)$_{b}$	3.7 (1.17)$_{bb}$	3.5 (1.15)$_{b}$	3.6 (1.16)$_{bb}$	3.0 (1.25)$_{a}$	2.9 (1.27)$_{aa}$
Social Support (1757)	4.1 (1.40)	4.3 (1.33)$_{c}$	4.3 (1.34)$_{cc}$	4.0 (1.37)$_{b}$	4.0 (1.38)$_{bb}$	4.1 (1.40)$_{bc}$	4.2 (1.42)$_{bbcc}$	3.7 (1.49)$_{a}$	3.7 (1.46)$_{aa}$
Negative Responses (1612)	2.0 (1.50)	2.2 (1.57)$_{b}$	2.1 (1.54)$_{cc}$	2.0 (1.52)$_{b}$	2.0 (1.53)$_{bbcc}$	1.8 (1.38)$_{a}$	1.8 (1.42)$_{bb}$	1.6 (1.38)$_{a}$	1.5 (1.30)$_{aa}$
Solicitous Responses (1608)	3.1 (1.51)	3.4 (1.59)$_{c}$	3.4 (1.59)$_{cc}$	2.9 (1.43)$_{b}$	3.0 (1.47)$_{bb}$	3.3 (1.43)$_{c}$	3.4 (1.44)$_{cc}$	2.6 (1.43)$_{a}$	2.6 (1.35)$_{aa}$
Distracting Responses (1606)	2.5 (1.25)	2.7 (1.30)$_{b}$	2.6 (1.30)$_{bb}$	2.4 (1.20)$_{a}$	2.5 (1.22)$_{aabb}$	2.7 (1.22)$_{b}$	2.7 (1.24)$_{bb}$	2.3 (1.26)$_{a}$	2.3 (1.20)$_{aa}$
Household Chores (1762)	3.2 (1.49)	2.7 (1.47)$_{a}$	2.7 (1.47)$_{aa}$	3.2 (1.42)$_{b}$	3.2 (1.41)$_{bb}$	3.6 (1.45)$_{b}$	3.6 (1.51)$_{cc}$	4.0 (1.31)$_{c}$	4.0 (1.33)$_{dd}$
Outdoor Activities (1760)	1.4 (1.42)	1.0 (1.34)$_{a}$	1.0 (1.31)$_{aa}$	1.4 (1.38)$_{b}$	1.3 (1.36)$_{bb}$	1.5 (1.51)$_{b}$	1.5 (1.54)$_{bb}$	1.9 (1.41)$_{c}$	1.9 (1.46)$_{cc}$
Activities Away from Home (1762)	1.8 (1.10)	1.5 (1.08)$_{a}$	1.5 (2.10)$_{aa}$	1.8 (1.03)$_{b}$	1.8 (1.02)$_{bb}$	2.1 (1.07)$_{c}$	2.1 (1.11)$_{cc}$	2.3 (1.07)$_{d}$	2.4 (1.10)$_{dd}$
Social Activities (1762)	2.4 (1.07)	2.0 (1.07)$_{a}$	2.0 (1.06)$_{aa}$	2.3 (.98)$_{b}$	2.3 (.99)$_{bb}$	2.7 (1.10)$_{c}$	2.6 (1.12)$_{cc}$	2.8 (.98)$_{c}$	2.9 (.99)$_{cc}$
General Activity Index (1763)	2.2 (.97)	1.8 (.97)$_{a}$	1.8 (.95)$_{aa}$	2.2 (.91)$_{b}$	2.2 (.91)$_{bb}$	2.5 (.90)$_{c}$	2.4 (.94)$_{cc}$	2.8 (.83)$_{d}$	2.8 (.85)$_{cc}$
SF-36									
Physical functioning (1767)	48.9 (22.22)	39.9 (20.9)$_{a}$	40.2 (20.87)$_{aa}$	47.4(20.75)$_{b}$	47.6 (21.02)$_{bb}$	54.9(20.71)$_{c}$	53.8 (21.17)$_{cc}$	63.1(20.86)$_{d}$	64.0 (20.83)$_{dd}$
Role Physical (1747)	12.2 (24.59)	4.7 (13.79)$_{a}$	5.0 (14.30)$_{aa}$	9.7 (21.06)$_{b}$	9.6 (20.94)$_{bb}$	18.3(28.42)$_{c}$	18.2 (28.28)$_{cc}$	25.3(35.00)$_{d}$	26.3 (36.06)$_{dd}$
Bodily Pain (1769)	21.6 (14.39)	15.4(12.23)$_{a}$	15.4 (12.12)$_{aa}$	20.8(13.18)$_{b}$	20.6 (13.25)$_{bb}$	25.8(14.24)$_{c}$	25.3 (14.52)$_{cc}$	30.5(15.29)$_{d}$	31.7 (15.05)$_{dd}$
General health (1760)	35.1 (20.62)	26.6 (17.9)$_{a}$	26.6 (17.92)$_{aa}$	33.1(18.07)$_{b}$	33.1(18.42)$_{bb}$	41.0(20.55)$_{c}$	41.0 (20.66)$_{cc}$	49.9(21.62)$_{d}$	50.6 (21.76)$_{dd}$

Variable *(total completers N)*	**TOTAL** *(N=1775)* Mean *(SD)*	**LOW** Mean *(SD)*		**Low AE- High PW** *Mean (SD)*		**High AE - Low PW** Mean *(SD)*		**HIGH** Mean *(SD)*	
		LCA-clusters (N=526)	**Clinical Algorithm (N=468)**	**LCA-clusters** *(N=654)*	**Clinical Algorithm** *(N=744)*	**LCA-clusters** *(N=347)*	**Clinical Algorithm** *(N=336)*	**LCA-clusters** *(N=242)*	**Clinical Algorithm** *(N=227)*
Vitality (1770)	20.8 (17.80)	14.6 (15.74)$_a$	14.9 (15.53) $_{aa}$	19.4(16.44)$_b$	19.2 (16.37) $_{bb}$	27.3(17.98) $_c$	26.6 (18.68) $_{cc}$	28.1(19.35) $_c$	29.5 (19.51) $_{cc}$
Social functioning (1771)	41.5 (25.66)	28.0 (21.2)$_a$	28.2 (21.16) $_{aa}$	39.7(23.00)$_b$	39.2 (23.06) $_{bb}$	50.1(23.44) $_c$	49.7 (24.06) $_{cc}$	61.9(25.69)$_d$	64.4 (25.07) $_{dd}$
Role emotional (1726)	38.0 (41.90)	19.8 (34.2) $_a$	20.5 (34.54) $_{aa}$	40.0(42.05)$_b$	38.5 (41.83) $_{bb}$	42.8(41.55)$_b$	42.3 (41.93) $_{bb}$	63.0(40.28) $_c$	65.3 (39.09) $_{cc}$
Mental Health (1767)	49.4 (22.30)	37.1(20.43)$_a$	37.3(20.43)$_{aa}$	49.8(21.04)$_b$	49.5 (21.23) $_{bb}$	55.3(19.55) $_c$	54.0 (19.93) $_{cc}$	65.6(18.37)$_d$	67.2 (17.85) $_{dd}$
Physical Component Summary (1697)	28.2 (8.07)	26.2 (6.68) $_a$	26.3 (6.66) $_{aa}$	27.0 (7.65) $_a$	27.1 (7.80) $_{aa}$	30.4 (8.30) $_b$	30.2 (8.27) $_{bb}$	32.1 (9.22) $_c$	32.2 (9.10) $_{cc}$
Mental Component Summary (1697)	33.0 (12.75)	26.0(10.43)$_a$	26.2 (10.31) $_{aa}$	33.4(12.42)$_b$	32.9 (12.47) $_{bb}$	36.0(11.63) $_c$	35.6 (11.87) $_{cc}$	41.7(11.99)$_d$	42.8 (11.51) $_{dd}$
EQ-5D									
Mobility (1764)	1.6 (.50)	1.8 (.44) $_d$	1.8 (.46) $_{dd}$	1.7 (.50) $_c$	1.7 (.49) $_{cc}$	1.5 (.51) $_b$	1.5 (.51) $_{bb}$	1.4 (.49) $_a$	1.4 (.48) $_{aa}$
Self-Care (1764)	1.3 (.45)	1.4 (.50) $_c$	1.4 (.50) $_{cc}$	1.3 (.45) $_{bc}$	1.3 (.46) $_{bb}$	1.2 (.41) $_{ab}$	1.2 (.39) $_{aa}$	1.1 (.36) $_a$	1.1 (.31) $_{aa}$
Usual Activities (1760)	2.1 (.63)	2.3 (.56) $_c$	2.3 (.57) $_{cc}$	2.2 (.60) $_b$	2.2 (.59) $_{bb}$	1.8 (.60) $_a$	1.8 (.60) $_{aa}$	1.7 (.62) $_a$	1.7 (.62) $_{aa}$
Pain/discomfort (1745)	2.7 (.48)	2.8 (.39) $_d$	2.8 (.39) $_{dd}$	2.7 (.47) $_c$	2.7 (.47) $_{cc}$	2.5 (.52) $_b$	2.5 (.52) $_{bb}$	2.4 (.50) $_a$	2.4 (.50) $_{aa}$
Anxiety/Depression (1761)	2.1 (.60)	2.4 (.56) $_c$	2.4 (.56) $_{cc}$	2.1 (.58) $_b$	2.1 (.59) $_{bb}$	2.0 (.53) $_b$	2.1 (.54) $_{bb}$	1.8 (.57) $_a$	1.7 (.57) $_{aa}$
VAS	38.0 (19.47)	29.0 (16.59) $_a$	29.1 (16.45) $_{aa}$	36.7 (17.75) $_b$	36.2 (17.95) $_{bb}$	44.8 (19.10)$_c$	44.8 (19.51) $_{cc}$	50.5 (19.68) $_d$	52.0 (18.93) $_{dd}$
EQ-index (1721)	0.2 (.31)	0.1 (.24) $_a$	0.1 (.25) $_{aa}$	0.2 (.29) $_b$	0.2 (.29) $_{bb}$	0.3 (.32) $_c$	0.3 (.32) $_{cc}$	0.4 (.31) $_d$	0.5 (.30) $_{dd}$

NOTE: The a, b, c, d subscripts indicate statistically significant differences between the 4 LCA clusters (being a the smallest and d the highest value) while the aa, bb, cc, dd indicate statistically significant differences between the 4 clinical clusters, all calculated with post-hoc at $p < .05$

Abbreviations: CPAQ-8: Chronic Pain Acceptance Questionnaire- 8 items; **HAD:** Hospital Anxiety and Depression Scale, **MPI:** Multidimensional Pain Inventory; **EQ-5D:** EuroQuol, quality of life measure; **SF36**, Medical Outcome Study Short Form 36; **TSK:** Tampa Scale for Kinesiophobi

Figures

Figure 0 (part of the supplementary material) : Visual limits and patients' distribution of the LCA clusters and how the streight cutoffs were drawn

Figure 1 Visual cutoffs for the ACTiveAssessment clinical clusters

Figure 2a-2d ROC Curves Graphs and the Areas Under the Curves reflecting specificity and sensitivity of the ACTiveAssessment clinical clusters to identify the LCA clusters

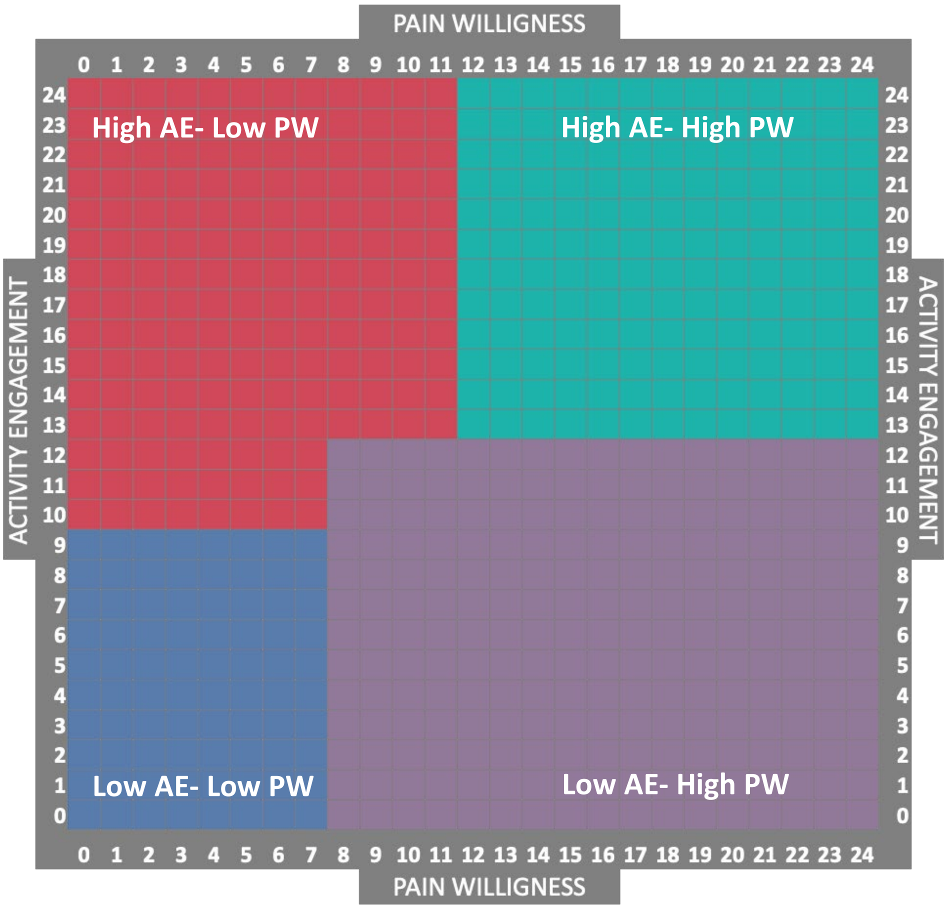

Figure 1. The clinical cutoffs for the four pain acceptance- behavioral profiles. The green area (upper right) represents patient scoring high in both AE and PW, while the blue area (lower left) represents the patients that scored low in both behaviors. The purple area (lower right) are the patients that scored higher in PW than in AE and the red area (upper left) represent the opposite combination.

Figure 1 in black and white for the printed version

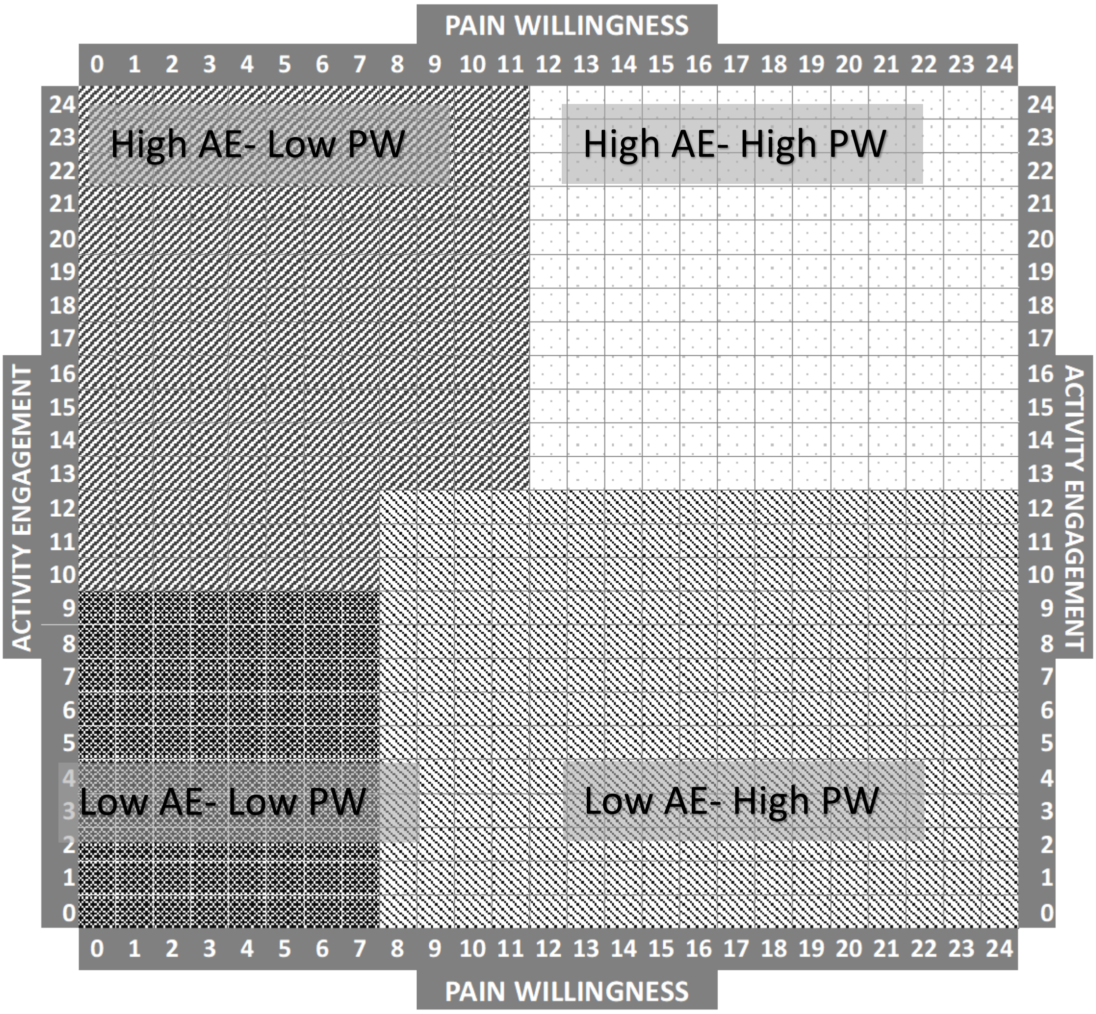

Figure 1. The clinical cutoffs for the four pain acceptance- behavioral profiles. The upper right area with light dots represents those that score high in both AE and PW, while the lower left area with heavy dots represents the patients that scored low in both behaviors. The lower right area are the patients that scored higher in PW than in AE and the upper left area represent the opposite combination.

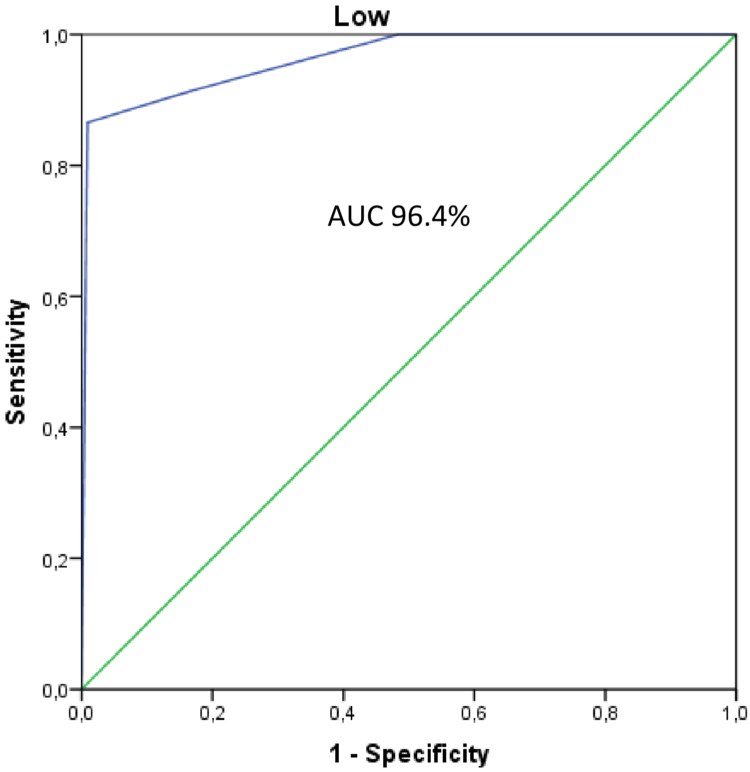

Figure 2a. ROC curve for the 'Low' cluster created by the clinical useful cutoffs compared with the LCA -derived 'Low' cluster shows the strength of the association between the LCA-clusters and the ones created by the clinical useful cutoffs, with an area under the curve of 96.4%.

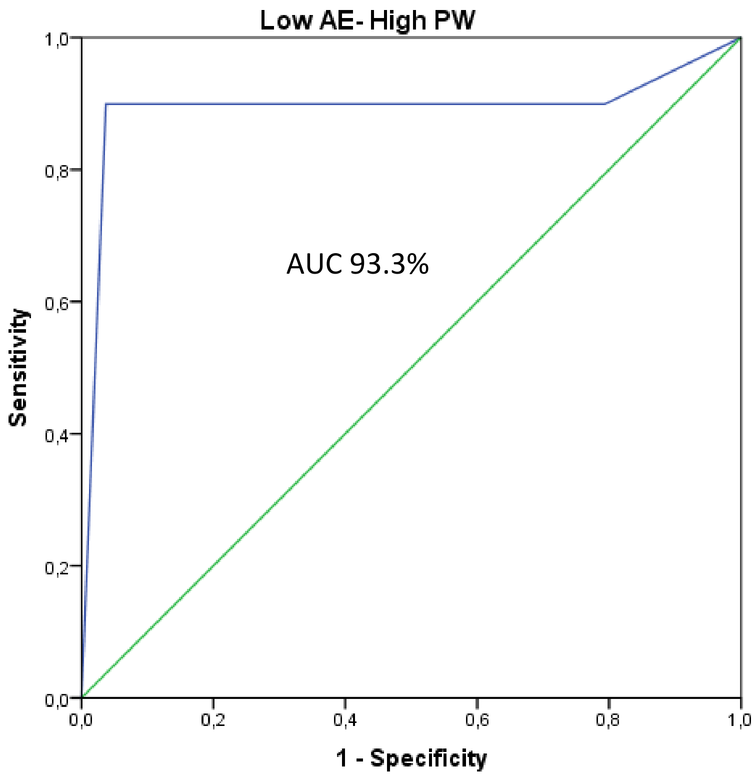

Figure 2b. ROC curve for the 'Low AE- High PW' cluster created by the clinical useful cutoffs compared with the LCA -derived 'Low AE- High PW' cluster shows the strength of the association between the LCA-clusters and the ones created by the clinical useful cutoffs, with an area under the curve of 93.3%.

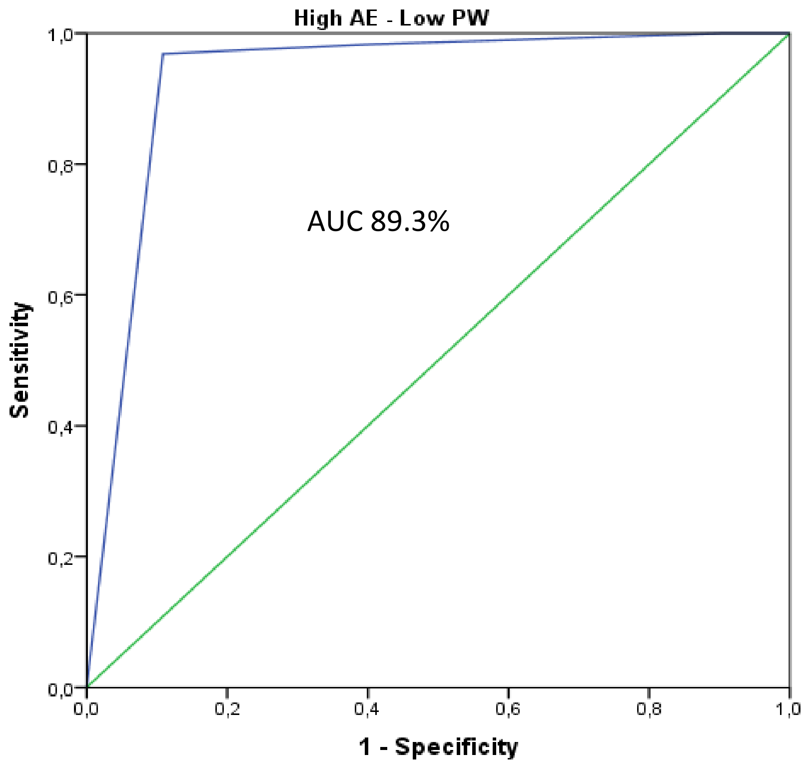

Figure 2c. ROC curve for the 'High AE- Low PW' cluster created by the clinical useful cutoffs compared with the LCA -derived 'High AE- Low PW' cluster shows the strength of the association between the LCA-clusters and the ones created by the clinical useful cutoffs, with an area under the curve of 89.3%.

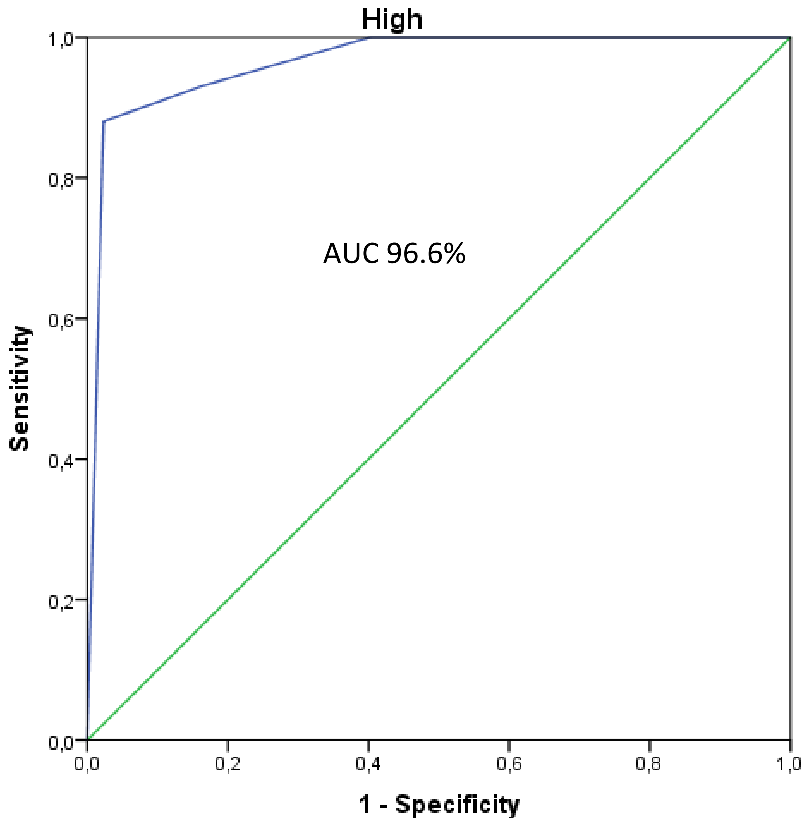

Figure 2d ROC curve for the 'Low' cluster created by the clinical useful cutoffs compared with the LCA -derived 'High' cluster shows the strength of the association between the LCA-clusters and the ones created by the clinical useful cutoffs, with an area under the curve of 96.6%.